PROBING THE SUN'S SECRETS

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Scientists of the Siberian Institute of Geomagnetism, Ionosphere and Radio-wave Propagation have begun testing a model of a solar radio-telescope. The full scale telescope will be erected on a field of nearly fifty hectares in the Bodar district near Lake Baikal. Our correspondent asked the director of the institute, corresponding member of the USSR Academy of Sciences, Vladimir Stepanov and the head of the radio-astronomy laboratory Gennady Smolkov, to give their comments of this matter.

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Q. What was the reason for building this radio-telescope?

A. The Directives of the 24th Congress of the CPSU provided for scientific research in the fields of long-distance radio communications, television and weather forecasting in the coming five-year plan period. The scientists will also continue their research into the fundamental problems of astrophysics, interplanetary space, solar physics and interactions between the sun and earth.

At present the sun presents us with unsolved puzzles concerning its spots, chromosphere eruptions and accompanying phenomena. During these bursts of activity the sun emits an enormous amount of energy in the form of waves and corpuscular radiation. The former take 8.3 minutes to reach the Earth, the latter several days. They cause interruption of radio communications, severe distortion of the Earth's magnetic field, affect the weather and even the condition of human beings suffering from cardio-vascular diseases. The level of radiation in the vicinity of the Earth increases to such an extent that it becomes dangerous for cosmic flights.

In order to learn how to forecast these eruptive solar processes and their geophysical consequences, it is necessary to have full knowledge of their mechanism and dynamics.

Q. But there are many other solar laboratories in the world.

A. True. In our institute we have several optical telescopes for different purposes. They enable us to study the surface, or photosphere of the sun, others the lower layers of the solar atmosphere, the chromosphere. Using a telescope with a device for creating an artificial solar eclipse, i.e. a solar coronagraph we can study the outer layers of the sun's atmosphere, its corona. However we see only that part which is at right angles to the line of sight and not that which faces the Earth. The latter will be visible either a week earlier or a week later due to the rotation of the Sun. Optical observation is greatly dependent on the weather and therefore the instruments at our disposal are unable to cover all the aspects of solar research. It is impossible to study the structure, dynamics, origin and mechanisms in active areas of the solar atmosphere where these eruptions occur without the use of

radio-astronomical methods. For this reason the radio telescope is an essential aid for the scientists.

The plasma in the solar atmosphere radiates a continuous spectrum of radio-waves. However the density of the atmosphere falls the further it is from the surface of the Sun. For this reason the wavelength of the radiation changes from a few millimetres near the surface of the Sun to tens of metres in the outer corona. Radiation of greater or smaller wavelengths is absorbed by the Earth's atmosphere. In the active areas of the corona, the density and temperature of the plasma is much higher and the intensity of the radiation is greatly increased.

By turning their radio-telescope to different wavelengths the scientists can "examine" the solar atmosphere at various heights. The solar radio-telescope built several years ago in Australia is designed for wavelengths in the metre range. Ours will operate in the centimetre range.

Q. What is the radio telescope like?

A. It is a multi-element, cruciform radio interferometre with two rows of antennas, one directed east-west, the other north-south. It is supplied with complex electronic equipment. In designing the telescope many difficult technical problems had to be solved. For this reason it is necessary to check several of the technical problems connected with its design experimentally. This is why we built this model. It is not a miniature model, it consits of a number of antennae of the same size as the future telescope. The model will be used to check the solar tracking devices, reception of radiation, etc. A wave-guide several hundred metres long will be set up to check the tracking of the signals received from the antennae.

The large dimensions of the interferometer will give it high resolution, in the neighbourhood of 20 seconds of arc. Panoramic inspection of the Sun will be performed simultaneously in two directions. The telescope will give us such an enormous amount of information that it will be impossible to process it by hand. The scanning and processing of the data will be performed automatically by a computer which will control the telescope, collect and process the received signals and build a radio image of the Sun every few minutes. At the same time the operator at the control panel will be able to see this image on the screen of a television receiver.

The radio telescope will be able to register local sources of radiation whose intensity is ten times that of the quiescent solar corona. It will also be able to register eruptions which have an intensity a hundred times that of adjacent sources. It will enable us to follow fast transient processes in active areas of the lower layers of the corona. This will be the first instrument in the world having such characteristics and capabilities.

Q. What will this instrument give science in the final analysis?

A. The instrument at Bodar will be used for observations only. The theoretical conclusions from these observations will be drawn in the radio-astronomical laboratories of the institute which are connected by tele-type with the interferometer. In the laboratories scientists will be able to correlate processes observed by the radio-telescope with the structure of active areas observed optically in other observatories of the institute.

Finally, we will be able to construct a map depicting the distribution of the Sun's magnetic field in space. With its help, scientists will be able to forecast solar activity, determine the conditions for the transmission of radio signals and the conditions in space. All this is necessary for ensuring dependable short-wAve radio communications between the Earth and objects in space, between different points on the surface of the globe and the safety of life in space.

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Corresponding member of the USSR Academy of Sciences, A.Pistolkors is intimately concerned with the design of the radio telescope. He is scientific director of the project. In designing this instrument we received considerable assistance from the observatories and institutes of the USSR Academy of Sciences, from the Presidium of the Siberian section of the A.Sc. and from industrial institutes and organisations.

Q. When will the radio-telescope be put into operation?

A. We propose to finish working out the design problems of the model in the present year, said G.Smolkov. As soon as this is done we will start constructing the system in Bodar. The site has already been selected and all preliminary work has been done.

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